AutoEEG^{TM}: Automatic Interpretation of EEGs for Clinical Decision Support

J. Camaratta, I. Obeid and J. Picone
BioSignal Analytics, Inc.
{joe.camaratta, iobeid, joseph.picone}@gmail.com

Problem: An EEG is the primary tool for diagnosis of brain related illnesses, such as epilepsy and post-surgical neuropathology. It takes several years of training for a physician to achieve board certification for reading and reporting EEG studies. Longer-term monitoring studies (LTMs) of neurological activity, occurring over periods of several hours to days, are becoming increasingly important for diagnosing brain disorders and injury and for planning surgical and pharmaceutical therapies in patients who do not respond positively to first-line treatment using antiepileptic drugs. Each long-term or continuous EEG monitoring study requires a neurologist to review up to 72 hours of data in as little as 30 – 60 minutes. However, even when a neurologist is available, and despite rigorous training, there is only moderate inter-observer agreement in EEG interpretation. Hence, while the demand for LTMs is growing rapidly for diagnosis and treatment response, and EEGs are an efficient and effective method to meet this need, they are not being utilized to their capacity because of the bottleneck of accurately analyzing the data.

Solution: AutoEEG^{TM}, a BioSignal Analytics' software product, is a clinical decision support tool based on proven, advanced, deep learning technology. It reduces time to diagnosis, reduces error and is sufficiently lightweight to run on portable standalone platforms. This technology is able to identify EEG events in the signal and subsequently to provide a report that summarizes its findings based on the event detected. The transcribed EEG signals can be viewed from any portable computing device. It also has the ability to learn from data, helping in future decision making, providing real-time feedback to aid in diagnosis, and, for patients undergoing long-term monitoring, creating an alert when abnormal signals are identified. This market leading product (1) enables clinical neurologists employing a volume-based business model to decrease the time spent analyzing an EEG and thereby increase billing; (2) allows pharmas to assess changes quantitatively in neural activation during clinical trials; (3) allows neurologists to order and bill for substantially more long-term monitoring tests based on this proven decision support tool; (4) adds value to the commodity EEG headsets currently entering the market by providing meaningful, real-time signal analysis.

Markets: The ability to automatically predict life-threatening events such as seizures from EEG signals has been actively researched for the past 40 years. We have performed 101 interviews to better understand current solutions and unmet needs in EEG clinical analysis. Interviewees included 57 clinicians from academic medical centers and community hospitals, and 44 industry professionals with experience commercializing products to diagnosis and treat neurological disorders. All manufacturers interviewed, and 70% of neurologists interviewed, reported that the most pressing need for a new product was for more reliable automated seizure detection. More than half of the neurologists interviewed believed that automated seizure detection with real-time alerts of seizure events during long-term and continuous EEG monitoring would be highly beneficial in optimizing treatment using antiepileptic drugs. The target market is estimated to be $10M/yr., the serviceable available market is estimated to be $1.5B/yr. and the total addressable market is estimated to be $1T/yr.

IP Status: A provisional umbrella patent titled "Automatic Interpretation of EEGs using Semi-Supervised Deep Learning" has been filed that consists of five disclosures covering component technologies such as feature extraction, false alarm reduction, active learning and cohort retrieval.

Collaborators: This project is a collaboration between the University City Science Center and Temple University, who provided the seed funding for the commercialization effort and supported the creation of BioSignal Analytics, Inc. Clinical validation will include collaborators at several regional hospitals.

Next Steps: We are actively seeking SBIR/STTR funding to support phase II of the project, which will include extension of the technology to real-time seizure detection and a clinical evaluation.